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ABSTRACT

This guide presents three articles on athletic-field turf management. The articles explain how athletic-field managers can make a difference in playing surface quality, discusses the design and technical challenge behind athletic-field mowing patterns, and provides a form to help identify and document sports field problems. The articles are: (1) "Traction on Turf" (Andrew McNitt); (2) "Mowing Patterns" (David R. Mellor); and (3) "Evaluation of Athletic Fields" (H.L. Portz). (GR)

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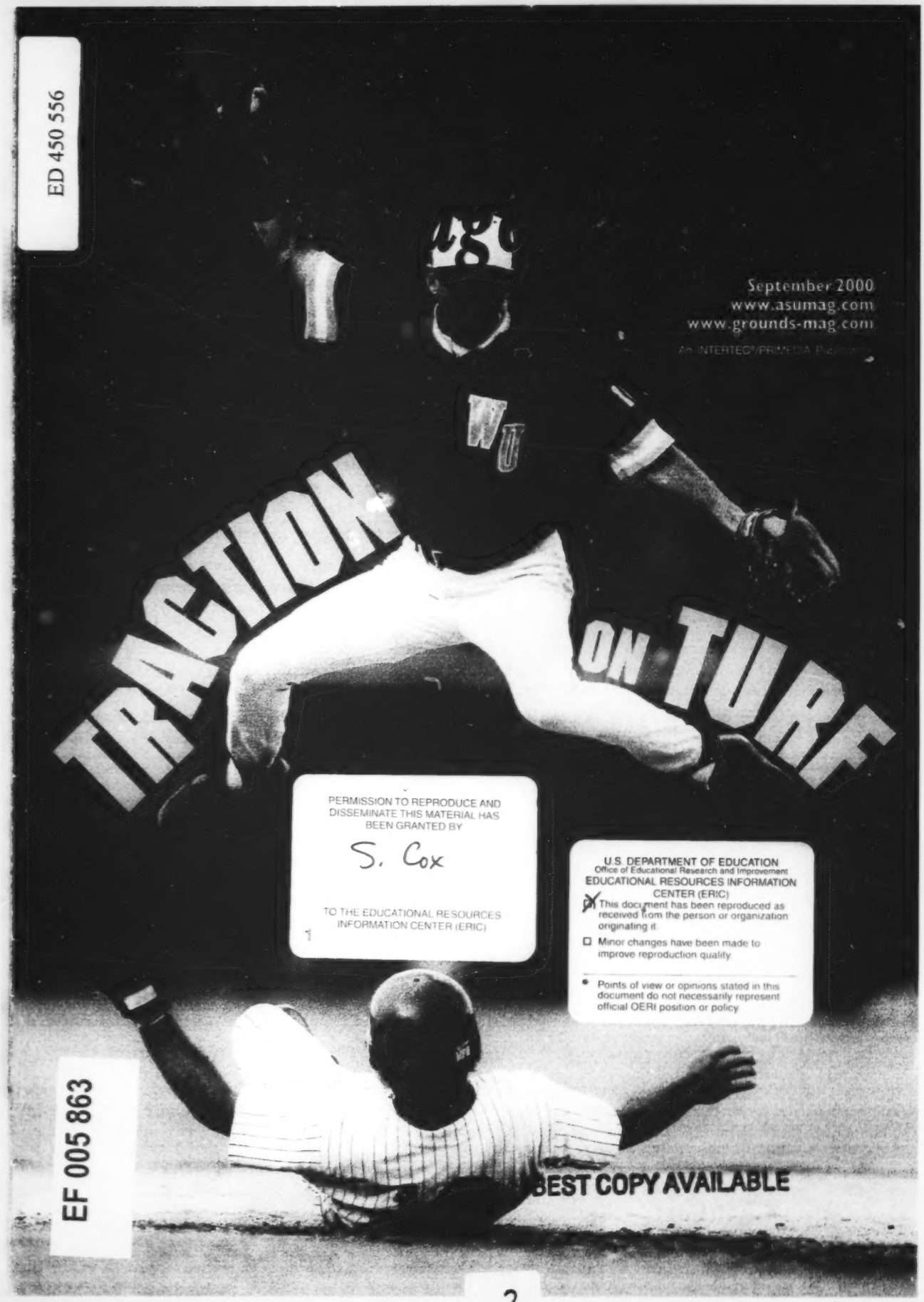

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SPORTS FIELD management guide

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Traction on turf

By Andrew McNitt, Pennsylvania State University

Athletic-field managers can make a difference in playing-surface quality.

With the introduction of synthetic turf in the 1970s, concern over injuries resulting from the condition of athletic-field playing surfaces became more intense. Researchers began recording the number of injuries occurring on synthetic- and natural-turf playing fields. Results of these studies were highly variable because playing-surface quality is affected by so many factors. Natural-turf playing-surface quality depends on soil texture, soil density, soil-water content, turfgrass species, cutting height and level of wear.

Grounds Maintenance

Traction is an important characteristic of athletic turf. However, our understanding of turf traction is still in its infancy.

In an early study at Pennsylvania State University, researchers examined 12 high-school-football programs. They found that 21 percent of the recorded injuries in games and practices were either definitely or possibly related to the playing surface. A follow-up study showed that athletic-field managers could affect playing-surface quality through management practices that affect soil-water content, soil density and turf cover. Good maintenance practices and better soil and turfgrass conditions

provided softer fields. Drier soil, high soil density and thin turf cover resulted in hard surfaces, while core-cultivated fields were noticeably softer than non-cultivated fields. Practice fields were harder than game fields, and high-wear areas were harder than low-wear areas.

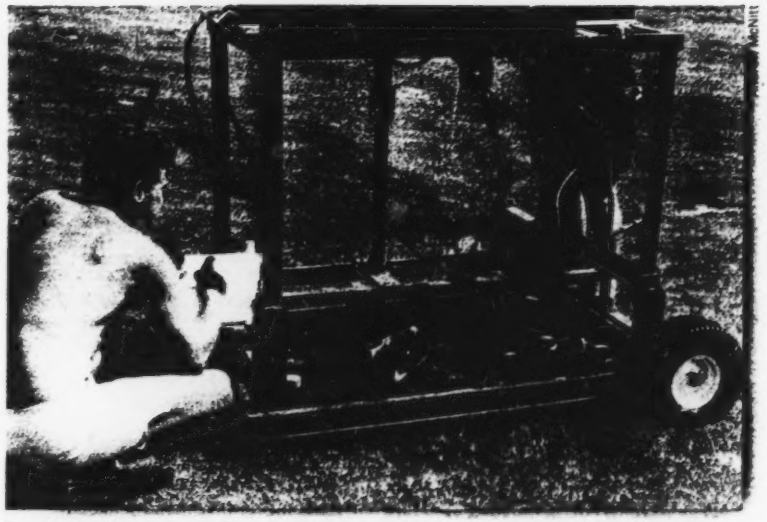
Measuring playing-surface quality

To make playing-surface and injury data useful, it is necessary to characterize the playing surface in question. Assessing playability and injury potential requires a quantitative method of evaluating playing surfaces that accounts for complex player-to-surface interactions. An athlete interacts with a playing surface in two general ways: falling on the surface and player-to-shoe-to-surface interactions. Surface hardness and traction affect these interactions respectively.

•**Hardness**. The ability of the surface to absorb impact energy created by a player is its *hardness*. Playing-surface hardness can affect both player performance and player safety and should not tend to either extreme. A soft field may create early fatigue in the leg muscles of a player, while hard fields can be dangerous in impact situations.

A device that measures impact absorption is the *Clegg impact tester*. This has become a useful tool for evaluating the surface hardness of athletic-field playing surfaces. Field managers, technical representatives and consultants have begun to use this device to demonstrate the usefulness of particular maintenance practices and construction designs.

In Europe, some researchers have suggested that managers use a system to evaluate soccer-field playability that relies on hardness and traction testing. The researchers developed the system using the Clegg impact tester to measure field hardness. To measure traction, they mounted cleats on a steel disk, weighted the disk with barbell weights and rotated it with a torque wrench. The researchers performed these tests on numerous fields prior to games and then questioned the athletes about field conditions. Although extremely broad, the European soccer system provides the first quantitative standard for athletic-field playability. However, these numbers say little about the safety of a field and a more detailed understanding of surface traction is necessary before researchers can suggest even general safety standards.



To adequately measure turf traction, it was necessary to invent a new device—*Pennfoot*.

•**Traction**. The effect a playing surface has on surface-to-shoe interaction is termed *footing*. An athletic-field surface should provide a level of footing that benefits the player's actions without causing excessive stress to joints or ligaments. The term refers to surface-to-shoe interactions of both smooth-soled and studded footwear. More specifically, the term *friction* applies to smooth-soled footwear while *traction* is relevant to footwear having studs, cleats or spikes to provide extra grip. Because of the danger of knee and ankle injuries to athletes wearing cleated shoes, sur-

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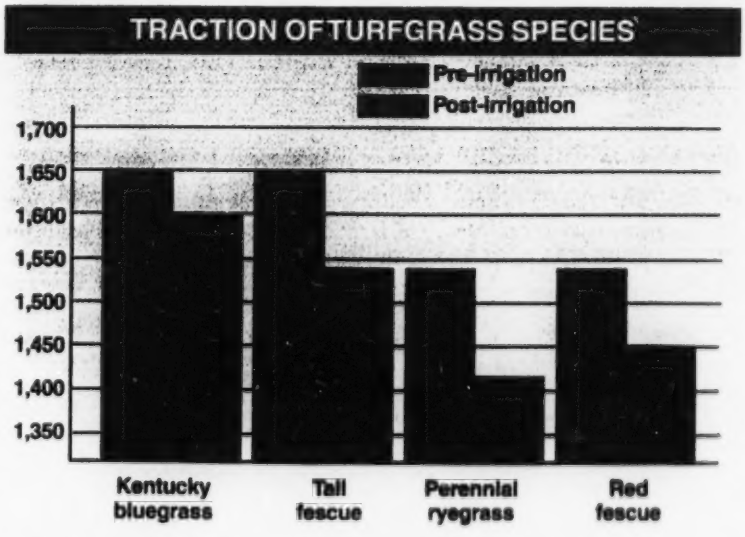


Before irrigation, Kentucky bluegrass and tall fescue had similar traction values. However, wet conditions reduce traction on tall fescue more than on Kentucky bluegrass. Perennial ryegrass had the lowest traction value in wet conditions.

face traction—the topic of this article—should be a primary concern of athletes, shoe manufacturers and field managers.

Researchers have developed various methods to measure the factors relating to traction. Differences among these methods include the shoe-sole surface material, vertical force, or *loading weight*, and whether the test method measures traction as the shoe sole rotates or with linear movement across the playing surface. The method that can best simulate the interaction of an athlete's foot in contact with the surface should provide the most meaningful measurement of traction.

At Penn State, we built a device that would measure both rotational and linear traction using actual athletic footwear and realistic loading weights. We named it *PENNFOOT*. This apparatus measures traction both linearly and rotationally using different shoes and various loading weights. We measured traction under various conditions and found that traction values differed by turfgrass species, cutting height, turf density, soil-water content and shoe type.

Turfgrass species

We looked at the traction characteristics of four cool-season turfgrass species: Kentucky bluegrass, perennial ryegrass, red fescue and tall fescue. In this study, Kentucky bluegrass and tall fescue had greater traction values than red fescue and perennial ryegrass. Although tall fescue had an *average* traction value similar to Kentucky bluegrass, traction on tall fescue was more variable than on any other species we tested. This may be due to the clumping growth habit of tall fescue, suggesting that maintaining stand density and uniformity for tall fescue may be even more important to providing consistent traction than it is for other species. This is a notable problem with tall fescue because of the tendency of the plants to tiller in response to injury. Under heavy use, tall-fescue turf may become clumpy and, possibly, more dangerous to athletes. Thus, tall fescue may not be the best choice for heavy-use fields. Rather, use it in softball outfields and general-use turf areas that receive less concentrated wear.

While tall fescue and Kentucky bluegrass had similar traction values over typical ranges of soil-water content, wet soil conditions affected Kentucky bluegrass less than other species we tested. This may, in part, be due to the rhizomatous growth habit of Kentucky bluegrass.

Perennial ryegrass and red fescue had significantly lower traction values than Kentucky bluegrass and tall fescue. However, relative to other species, perennial ryegrass establishes quickly, providing good early wear resistance. This compliments the traction and recuperative ability of Kentucky bluegrass. Thus, perennial ryegrass-

Continued...

TURF TRACTION—HARD TO GET A GRIP ON

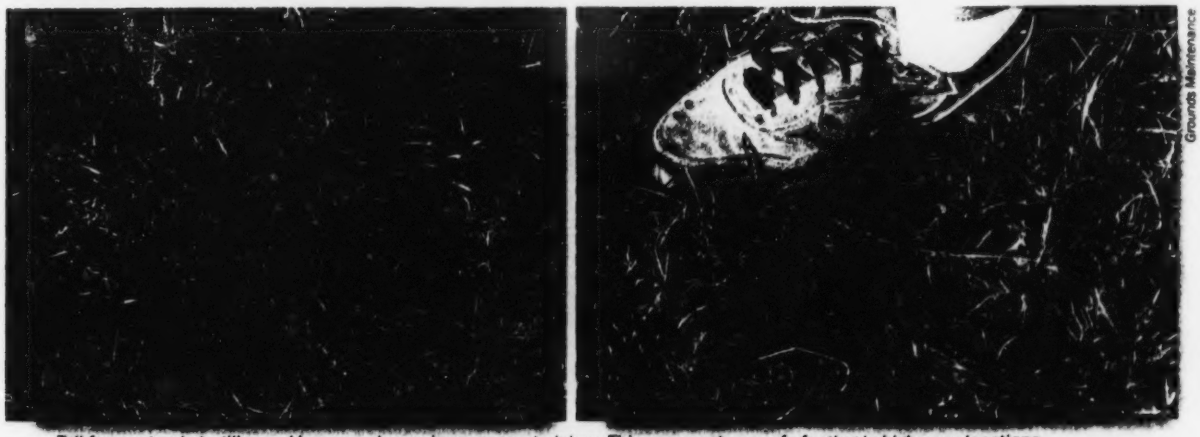
Representatives of various fields relate a consistent theme regarding turf traction: it isn't something they think about much.

Consistently, athletic turf managers relate that managing for overall turf health provides good traction conditions.

Likewise, athletic-shoe manufacturers design shoes without much thought to specific turfgrass varieties or conditions (aside from whether the turf is artificial or natural). Instead, they allow athletes to cope with varying field conditions by making shoes with replaceable cleats. When traction is poor, players just install longer cleats. A problem that prevents shoe manufacturers from producing shoes for specific turf conditions is cost. Specialized shoes would be produced and sold in small quantities, raising their price to a prohibitive level. Thus, shoe companies usually produce shoes designed for specific sports rather than specific field conditions.

NTEP shear-resistance ratings probably are more representative of traction quality than other turf measurements. However, because of the number of factors—besides the turfgrass variety itself—that affect traction, it is not easy for turfgrass breeders to select varieties for traction, per se.

For similar reasons, you would be unwise to use shear resistance as the primary criterion for selecting an athletic-field turfgrass. The ability to thrive in your local climate and site-specific conditions is the first quality for which you should look.



Grounds Maintenance

Tall fescue tends to tiller and become clumpy in response to injury. This can create unsafe footing in high-wear locations.

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Terry Porch
Tennessee Titans

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Dale Wysocki
Minnesota Vikings

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Trevor Vance
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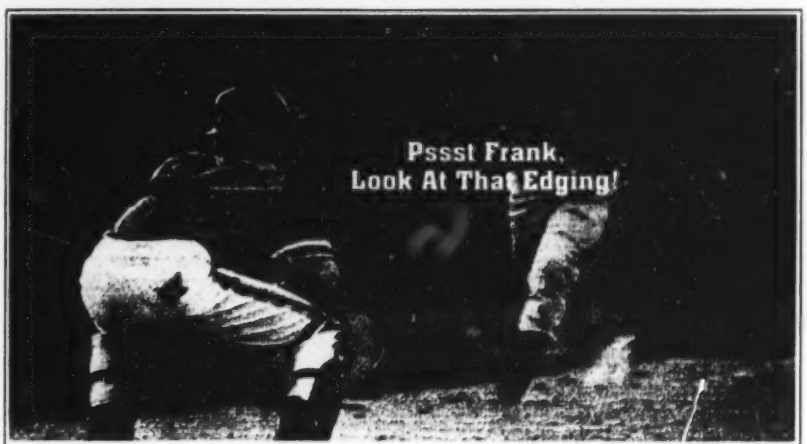
Kentucky bluegrass mixes are popular with many athletic-field managers.

Bermudagrass is a favorite warm-season species of many field managers, especially those of sand-based fields. Bermudagrass possesses high recuperative ability, and its stolons and thatch add stability to the naturally unstable sand, creating a good base for cleat penetration. Zoysiagrass also has favorable traction qualities, as well as excellent wear resistance, but recuperates from injury slowly. Turfgrass breeders are working towards improving zoysiagrass in this respect.

Unfortunately, we still have a great deal to learn about the differences among turfgrass species. This is partly due to a lack of research but also because so many other factors affect traction. Therefore, it is difficult to determine which effects result from the turfgrass variety itself. Clearly, we need more traction research on turfgrass species and varieties, as well as the variability that exists from area to area on athletic fields.



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Cultural practices

• **Cutting height.** Athletes often express the opinion that they experience greater traction on lower-cut turf. Some speculate that longer grass blades interfere with cleat penetration, leading to a reduction in traction. We found that maintaining turf at a cutting height of 1.5 inches resulted in consistently higher traction than turf maintained at 2.5 inches, regardless of species. However, we also measured traction on tall fescue before and after shaving off the leaf tissue and we found no difference in traction values relating to the presence or absence of leaf tissue. Thus, it appears that traction relates more to turf density than simply to height of cut. Turf maintained at a lower cutting height has higher density than turf maintained at a higher cutting height. Remember, however, that excessively short mowing weakens the stand and dramatically lowers turf density and traction. Thus, close mowing is not a guarantee of higher traction and must be high enough to sustain good turf health and density.

Step down mowing height before the start of the playing season early enough for the stand to adjust its density at the new mowing height. For example, if you have been cutting turf at 2.5 inches, you will not increase traction by mowing at 1.5 inches just prior to a game. Further, the shock to the plants probably will increase the chances of plant injury and thinner turf. Obviously, you should avoid this because exposed soil and thin turf provide the worst traction of all.

Also allow adequate time when you step up the cutting height. A good practice for fields that receive little summer use—such as schools that recess for the summer—is to incrementally raise mowing height as summer approaches; a practice that helps turf tolerate summer heat and drought. Then, as fall nears, gradually drop the cutting height back down over several mowings, rather than all at once.

• **Soil and water.** Soil quality affects traction several different ways. For

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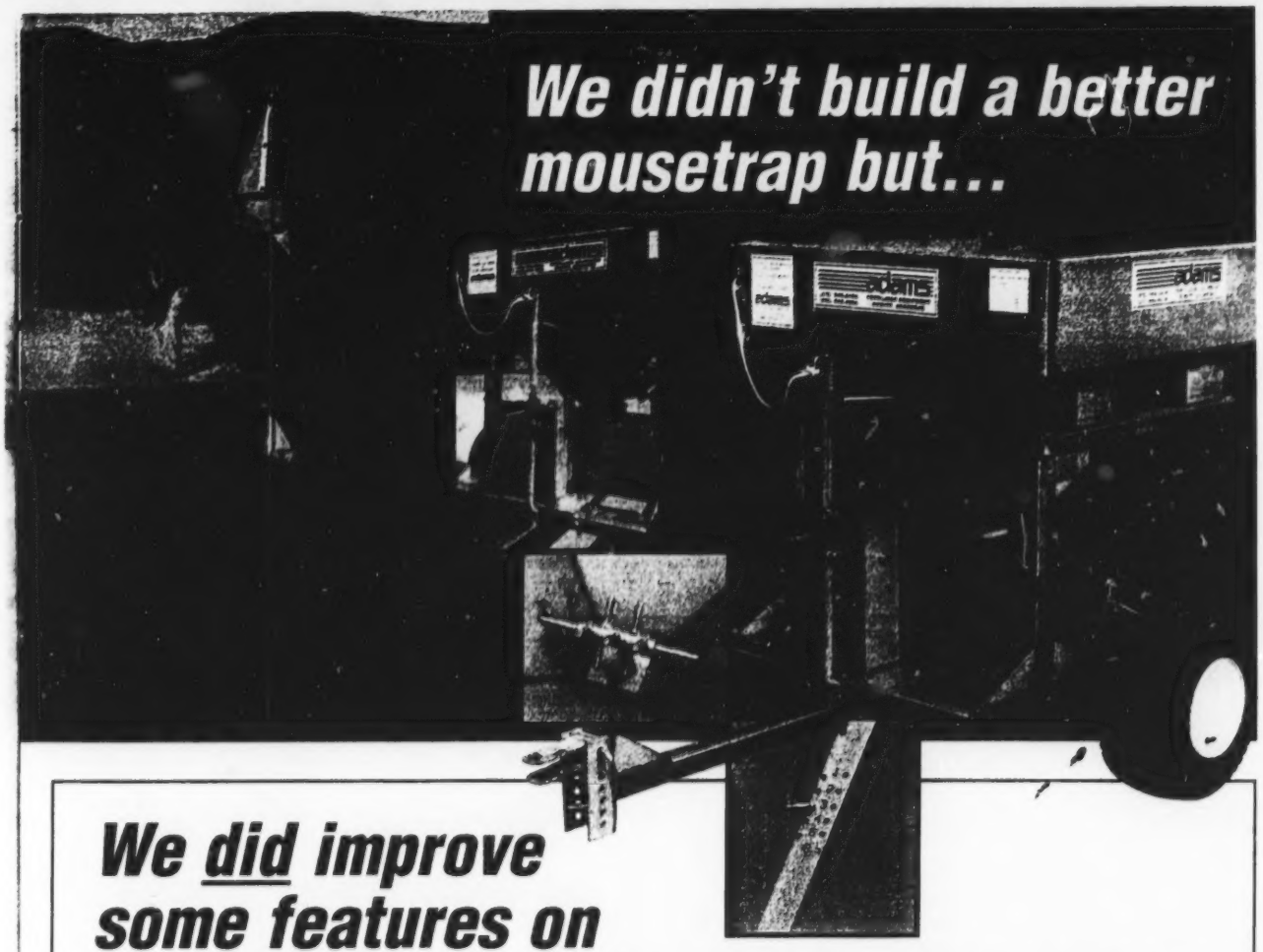

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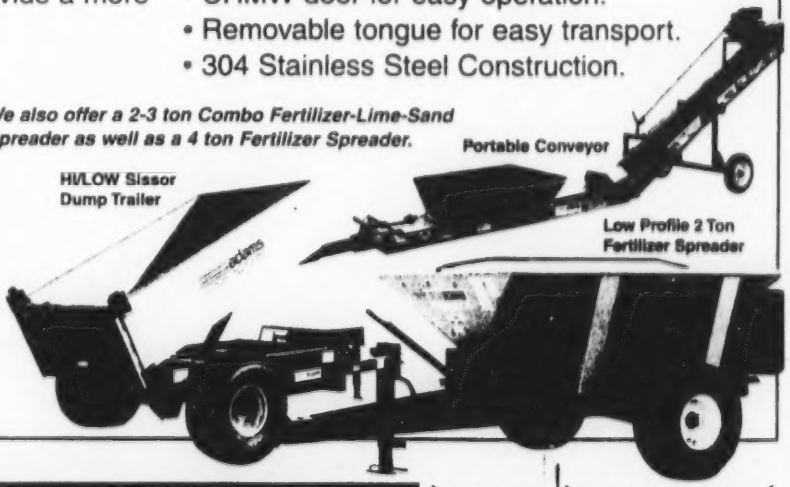

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Art exhibit focuses on mowing patterns

By David R. Mellor, Milwaukee Brewers Baseball Club

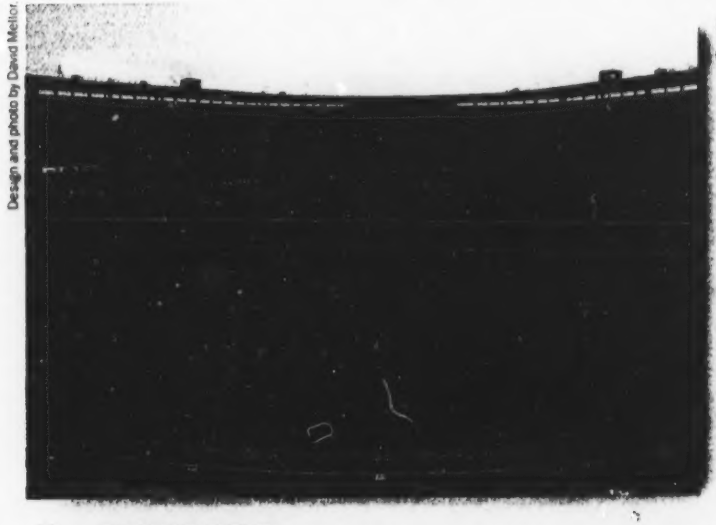
The aesthetics of a lovely mowing pattern can enhance any turfgrass area. From sports turf to landscaped turf areas, you can dress up any of them with a little creative thought.

As beautiful as these patterns can be, however, few people outside of the grounds-maintenance profession probably appreciate the design and technical challenge that goes into getting a pattern from paper and onto a field. That is, until now.

In fall 1996, to my surprise, Elizabeth Diller of the New York firm, Diller & Scofidio, contacted me. She described how her firm was organizing a touring art exhibit titled, "The American Home Lawn: Surfaces in Everyday Life." Her firm had seen TV highlights of baseball games and noticed the patterns on the Milwaukee (Wis.) Brewers Baseball Club's field. She asked me to send her some photos of patterns we'd designed for the field. After reviewing the photos, the firm's Gwynne Keathley asked if I would be willing to photograph patterns during the '97 season to include as part of the exhibit. I enthusiastically accepted.

Design by David Mellor. Photo by Jill Stoltz.

Any grounds manager who's gone to the trouble to mow a pattern into a client's lawn can appreciate the work that goes into it. Now the rest of the public can appreciate it too.



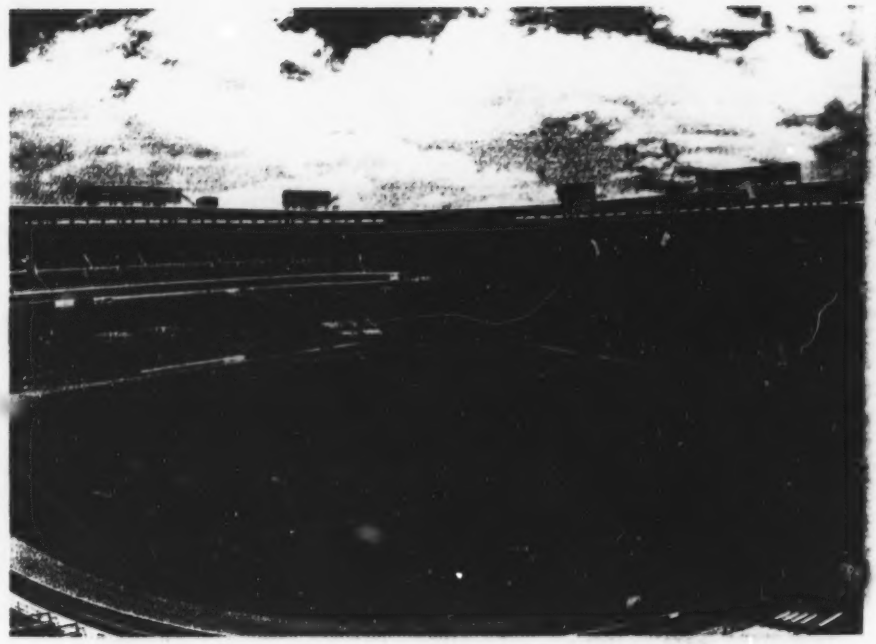
Design and photo by David Mellor.

Achieving our designs

Each design involves different challenges and needs individual strategies. We stress attention to detailing our entire turfgrass-management program. A healthy, actively growing turfgrass is a must for each design. And safety and playability of the field always come first. Only after we've ensured that we've met those aspects do we consider the aesthetics. After all, a design pattern should not affect the play of the game—only enhance the viewing of it. I feel it is important to enhance a fan's visit however possible and that a beautiful pattern adds to the aura

of our facility. I hope that when a fan sees our field in person or on TV, the pattern adds a little to his or her enjoyment of watching the game, and they remember the beauty as an added bonus.

Our office often gets phone calls from across the United States and Canada asking if we achieve the designs with paint, different types of grass or even different cutting heights. Actually, as most grounds managers already know, we achieve the look simply by using reel mowers with rollers, which bend the grass in the direction the mowers travel.



Design and photo by David Mellor

To begin each design, I think of the 100,000 square feet of our field's lush, dark-green 90-percent Kentucky bluegrass/10-percent perennial-rye mix as an oversized art canvas. Design ideas are always flowing among the staff, too, and we initially draw up the designs on the computer, though sometimes designs come in via a sketch pad or scrap of paper. Occasionally, we simply create a design by "eye" while mowing.

Sometimes an idea on paper doesn't work on the turf. A pattern needs to be pleasing to the eye, yet not too time- or labor-intensive. Plus, as I mentioned, we take extra care not to harm the turfgrass. Some designs are quite complicated and, to keep sections or lines exactly the same width, we use a tape measure and line strings for precision.

Mowing in patterns offers not only aesthetic results but agronomic ones too. This is because it is important not to mow the same direction every time. If you do, the grass blades start to lay down in that direction and can become stressed and weak. By designing a new pattern each time you mow, you not only improve the health of the turfgrass, you add a pattern that is pleasing to the eye.

Photographing for the exhibit

We photographed each pattern using a 17- to 24-mm wide-angle lens from two directions. We used a 24-mm setting for a view from the upper deck, directly behind home plate on the center axis. We photographed another view from our mascot's home "chalet" in center field at a 17-mm setting.

I photographed some of the patterns. Jill Stoltz, photographic intern, took others, along with team photographer Joe Picciolo's help and guidance.

In the exhibit, each slide was cropped identically. The images were then projected onto a large wall during a 26- to 28-slide presentation. Each image dissolvde into the next one as they appeared on the wall.

Seeing the exhibit

The exhibit included five sections, one of which focused on sports turf. Other parts of the exhibit featured golf courses and parks. It opens at Montreal's National Art Institute of Canada for a 3-month run, and was sponsored by the Canadian Center for Architecture. After its Canadian exhibition, it toured four to five museums in the United States for 2 to 3 years.

While some may think groundskeepers "just cut the grass," much more is involved in an overall turfgrass-management program. With million-dollar athletes on the field, we stress attention to every detail to ensure a "field of dreams." Patterns are just a small fraction of the tasks we perform. However, patterns—whether complex or basic—do take a special skill and touch to be done really well. When completed, they are another way to enhance the atmosphere at the ballpark. After all, when the fans walk to their seats, one of their first views is of the field. I feel it is important to make that moment memorable by letting the baseball diamond shine with a special design. We try to give a different meaning to the term "lawn art." **SFMG**

David R. Mellor is grounds manager of Milwaukee County Stadium (Milwaukee, Wis.).

The author wishes to gratefully acknowledge the continuing support of his supervisor, Gary Vanden Berg, in addition to Allen H. Selig, Milwaukee Brewers CEO/president and interim Major League Baseball commissioner; Wendy Selig-Prieb, Brewers vice president and general counsel; and Laural Prieb, Brewers vice president of corporate affairs. In addition, he notes the hard work of the entire grounds crew, in particular: Kirt Bakos, Kris Wodzinski, Joe Vopal and Sean Mantucca.

Evaluating an outdoor athletic facility

By H.L. Portz

Do you have a problem with your sports field? Here's a form you can use to help find out just what is wrong.

"What a terrific field!" You've heard it before and probably have said it yourself. Whether we're spectators, players or television viewers, we judge the field conditions. And the manager of that sports facility usually gets blamed for poor quality—unless mother nature has recently unleashed her fury.

What's the problem?

Those in charge—the owner or superintendent, the game manager or the maintenance crew—need to identify the problem(s) so they can correct and improve the situation.

- Is it *physical*—the site, soil or poor drainage?
- Is it *cultural*—the wrong turf species, poor establishment or maintenance practices?
- Is it *use*—heavy traffic, overuse, wear or misuse?
- Is it *money*—lack of or mishandled?
- Or is it *management*? Often, this is the real key.

To better evaluate athletic facilities, I developed a site evaluation for patterned after a form I used in turfgrass management classes at SIU-C and a turf-site evaluation form Kent Kurtz uses at Cal Poly—Pomona. The form, "Site and program evaluation of an outdoor athletic facility," accompanies this article. If you have a problem athletic field, why don't you try using the form?

SITE AND PROGRAM EVALUATION OF AN OUTDOOR ATHLETIC FACILITY

Date_____ Evaluator_____

I. DESCRIPTION OF FACILITY

A. Major athletic activity_____ Other_____

B. Administrative unit _____

C. Address/location_____

D. Contact person_____ Telephone _____

II. SITE AND PROGRAM EVALUATION

A. Physical site characteristics and problems:

1. Site size_____ Description (sketch on separate sheet)_____

2. Soil physical properties: Soil type_____ _____

Soil texture_____ Soil structure_____

3. Soil chemical properties: pH_____ P_____ K _____

Other tests (C.E.C., etc.) _____

4. Drainage: Percent slope (crown)_____ Tile_____ Other _____

Current drainage problems_____

5. Compaction: Compacted layer _____

Water infiltration problems _____

Modification needed _____

6. Playing surface condition (infield, outfield, etc.) _____

_____

B. Cultural and maintenance practices:

1. Turfgrass species and cultivars (if known) and % of each _____

_____ _____%

_____ _____%

_____ _____%

Total coverage of desirable grasses _____

2. Date and method of establishment _____

_____

3. Current weed(s) species or kind and % coverage

Broadleaf _____ _____%

_____ _____%

Grassy _____ _____%

_____ _____%

4. Condition of turfgrass (disease, wear or other problems)

Past problems _____

Present _____

5. Renovation and reseeding practices _____

_____

6. Fertilization and liming

Liming history and present program _____

_____

Fertilizer applied	Application date	Application rate
_____	_____	_____
_____	_____	_____
_____	_____	_____

7. Mowing schedule (note variation in season or area)

Season	Height	Frequency	Equipment used
_____	_____	_____	_____
_____	_____	_____	_____

Continued...

8. Cultivation—list type, i.e., aerification, slicing, dethatching, topdressing, etc., regularity and equipment used

_____

_____

_____

9. Irrigation practices _____

_____

10. Pest problems (disease, insect, weed, rodent) and controls

Type of problem	Remedy (pesticide)	Rate used	When applied
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

C. Use:

1. Major activity _____ Intensity _____

Other _____

2. Use conditions (too wet, overuse, etc.) _____

_____

D. Budget for field maintenance:

1. Current _____ 2. Future _____

3. Planned improvements _____

4. Problems _____

E. Management:

1. Site (Note joint usage, maintenance responsibility, etc.) _____

_____

_____

2. Program and responsible individuals _____

_____

_____

III. RECOMMENDATIONS—site, soil, turfgrass culture, use and management:

_____

_____

_____

_____

_____

Dr. H.L. Portz served as professor emeritus at Southern Illinois University—Carbondale.

SFMG

SPORTS FIELD management guide

Grounds Maintenance

ASU American School & University

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TRACTION ON TURF

Continued from page SFMG 8

instance, soil that is too wet provides little stability, but soil that is dry tends to inhibit cleat penetration. Thus, drainage properties greatly affect traction. Another example is sandy soil, which does not have the integrity of more finely textured soils. Anyone who has spent time at the beach already understands that the best traction is not in dry sand but on the moist sand at the waters edge, where the sand is firmest. By drying out their sand-based fields before a game, some field managers actually reduce traction. This illustrates the need for turf managers to understand their soils.

Not only does soil affect traction directly (with penetrating cleats, for example), it also affects anchorage for turfgrass roots. An interesting example of how this can affect traction occurred on the practice fields of the San Francisco 49ers. At one time, these fields were Kentucky bluegrass, it was difficult to keep out annual bluegrass. Because these are sand-based fields, foot traffic easily dislodged the weakly rooted annual bluegrass, leaving exposed soil and poor field conditions.

The 49ers have since replaced the Kentucky bluegrass with bermudagrass, and this seems to have solved the problem. Bermudagrass' dormant period allows more aggressive weed-control measures against the annual bluegrass. The bermudagrass is mowed at 1 inch; any lower than this results in excessive turf damage.

Fortunately, soil-moisture levels favorable for growing turf are usually within a range that provides good traction as well. In fact, most management practices that encourage turf health have a positive effect on traction, either directly or indirectly. Proper irrigation and fertility management increase turf vigor and recuperative ability; aeration decreases soil compaction and aids water infiltration; and overseeding promotes good stand uniformity and density. This leads to a point of major importance: Regardless of variety, healthy turf provides higher traction than a weak stand. Thus, good cultural practices and well-adapted turfgrass varieties should be the primary concerns of the athletic-field manager who wants to maintain good traction.

Creating a standard

Our understanding of playing-surface quality is still in its infancy. Hopefully, standardized tests that correlate well with athletes' subjective assessment of playing surfaces—as well as their actual performance—will emerge. It would then be possible to develop guidelines for proper construction and maintenance procedures to help the athletic-field manager provide a playing surface that maximizes player performance while minimizing the risk of injury. **SFMG**

Andrew McNitt is a turfgrass extension associate at the Pennsylvania State University, University Park.

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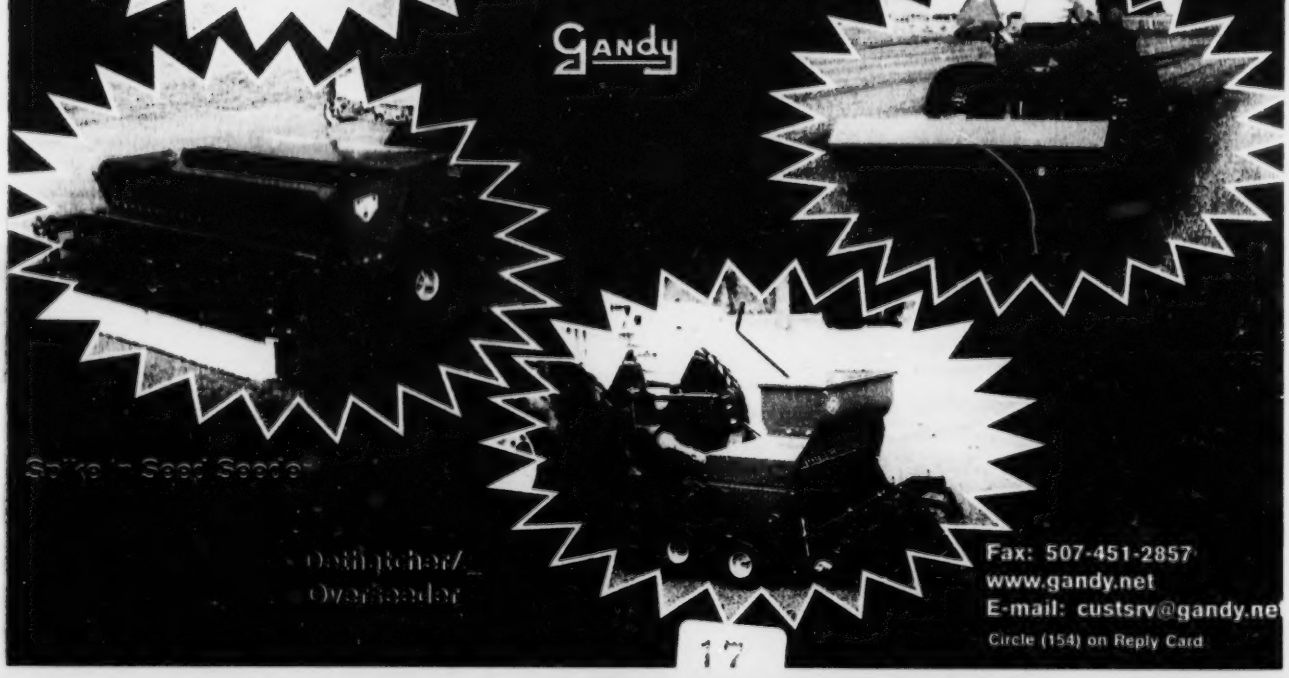

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